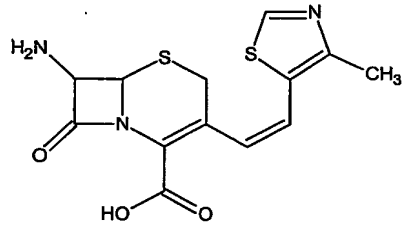
We Claim:

1. A process for preparation of cefditoren or a pharmaceutically acceptable salt or ester thereof, the process comprising:

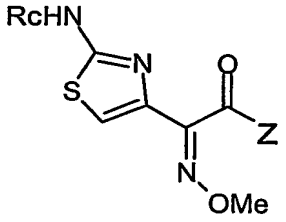
a) reacting a compound of Formula IX with a compound of Formula X wherein Z is selected from Formulae Xa, Xb, Xc and Xd and R_c is selected from trityl (triphenylmethyl), acetyl, benzhydryl or acetamidophenyl, R is C_1 to C_7 straight or branched chain alkyl, alkenyl, alkynyl or C_6 to C_{10} aryl or aralkyl, R_1 is C_{1-6} straight or branched chain alkyl, cycloalkyl, aryl, aralkyl or a heterocycle residue,

b) isolating cefditoren or pharmaceutically acceptable salt thereof from reaction mass, and

c) optionally converting cefditoren or pharmaceutically acceptable salt thereof to a pharmaceutically acceptable ester of cefditoren.

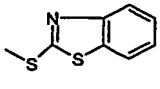


FORMULA IX

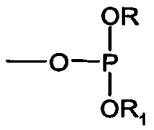


Formula X

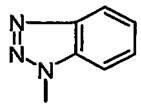
wherein Z is Compound of Formula Xa or Xb or Xc or Xd



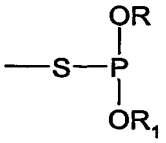
Formula Xa



Formula Xb



Formula Xc



Formula Xd

2. The process according to claim 1, wherein the compound of Formula IX comprises less than 2% of E-isomer.

3. The process according to claim 1, wherein the compound of Formula X has Z = Xa.

4. The process according to claim 3, wherein Formula X is *S*-(1,3-benzothiazol-2-yl)-(2-amino-1,3-thiazol-4-yl)(methoxyimino)ethanethioate.

5. The process according to claim 1, wherein step a) is carried out in presence of an organic solvent.

6. The process according to claim 5, wherein the organic solvent is selected from the group consisting of chlorinated hydrocarbon such as methylene chloride, chloroform, ethylene chloride or ethylene bromide; ethers such as tetrahydrofuran and diethyl ether; ketones such as acetone, methyl isobutyl ketone and methyl ethyl ketone; alcohols such as methanol, ethanol, propanol, isopropanol and butanol or mixtures thereof optionally containing water.

7. The process according to claim 1, wherein a base is used in step a).

8. The process according to claim 7, wherein the base is an inorganic base or an organic base.

9. The process according to claim 8, wherein the inorganic base is selected from the group consisting of sodium hydroxide, potassium hydroxide, calcium hydroxide, magnesium hydroxide, aluminium hydroxide, sodium hydride, potassium hydride, sodium carbonate, potassium carbonate, sodium bicarbonate or potassium bicarbonate.

10. The process according to claim 8, wherein the organic base is selected from the group consisting of an organic salt or an organic ammonium compound.

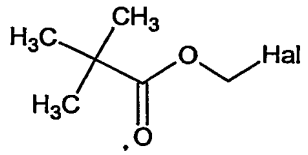
11. The process according to claim 10, wherein an organic salt is selected from sodium methoxide, potassium t-butoxide or sodium ethoxide.

12. The process according to claim 10, wherein an organic ammonium compound is selected from triethylamine, dicyclohexylamine or diphenylamine.

13. The process according to claim 1, wherein in step b) a salt of cefditoren is isolated.

14. The process according to claim 13, wherein a sodium or potassium salt of cefditoren is isolated.

15. The process according to claim 1, wherein salt of cefditoren is reacted with compound of Formula XI, to get cefditoren pivoxil.



FORMULA XI

16. A crystalline hydrate of cefditoren sodium.

17. A crystalline dihydrate of cefditoren sodium.

18. A crystalline cefditoren sodium having about 5.5 to about 7.5% of water by weight.

19. A crystalline hydrate of cefditoren potassium.

20. A crystalline dihydrate of cefditoren potassium.

21. A crystalline cefditoren potassium having about 5.5 to 7.5% of water.

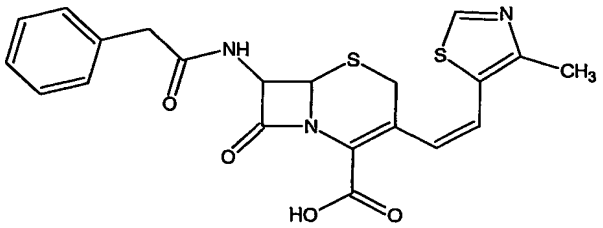
22. A process for preparation of cefditoren or a pharmaceutically acceptable salt or ester thereof comprising:

a) enzymatically deacylating a compound of Formula VIII to get a compound of Formula IX,

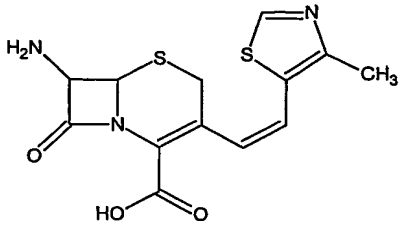
b) reacting the compound of Formula IX with a compound of Formula X wherein Z is selected from Formulae Xa, Xb, Xc and Xd, and R_c is selected from trityl (triphenylmethyl), acetyl, benzhydryl or acetamidophenyl, R is C_1 to C_7 straight or branched chain alkyl, alkenyl, alkynyl or C_6 to C_{10} aryl or aralkyl, R_1 is C_{1-6} straight or branched chain alkyl, cycloalkyl, aryl, aralkyl or a heterocycle residue,

c) isolating cefditoren or a pharmaceutically acceptable salt thereof from reaction mass,

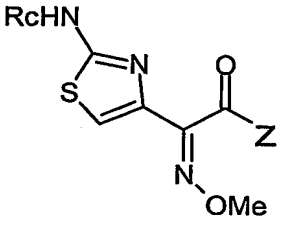
d) optionally converting cefditoren or the pharmaceutically acceptable salt thereof to a pharmaceutically acceptable ester of cefditoren.



FORMULA VIII

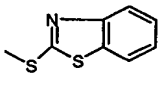


FORMULA IX

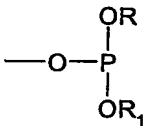


Formula X

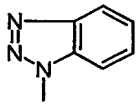
wherein Z is Compound of Formula Xa or Xb or Xc or Xd



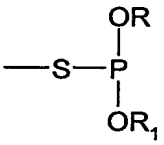
Formula Xa



Formula Xb



Formula Xc



Formula Xd

23. The process according to claim 22, wherein step a) is carried out in water, optionally containing an organic solvent.

24. The process according to claim 23, wherein the organic solvent can be water miscible or water immiscible.

25. The process according to claim 24, wherein the organic solvent is selected from the group consisting of methanol, ethanol, n-propanol, n-butanol, isopropanol, t-butanol, methyl formate, ethyl formate, ethyl acetate, n-butyl acetate, isopropyl acetate, tetrahydrofuran, 1,4-dioxane, diethyl ether, chloroform, methylene chloride, ethylene chloride, carbon tetrachloride, acetone, methyl isobutyl ketone, diisobutyl ketone, ethyl methyl ketone, methyl t-butyl ketone.

26. The process according to claim 22, wherein pH is maintained between about 5 to about 8 during step a).

27. The process according to claim 26, wherein the pH is maintained by using a base.

28. The process according to claim 27, wherein the base is selected from the group consisting of sodium carbonate, sodium bicarbonate, sodium hydroxide, potassium hydroxide, potassium bicarbonate, potassium carbonate or water soluble ammonium compounds such as ammonium hydroxide or triethylamine.

29. The process according to claim 22, wherein step a) is carried out using an enzyme belonging to the class of penicillin acylases or penicillin amidases.

30. The process according to claim 29, wherein the enzyme is penicillin G amidase.

31. The process according to claim 30, wherein the enzyme is used in immobilized form.

32. A process for the preparation of a compound of Formula IX, comprising:

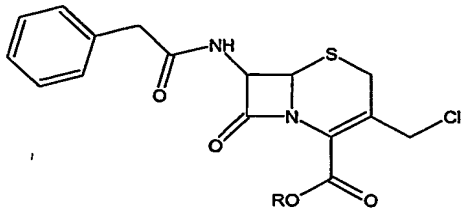
a) treating a compound of Formula II with an alkali or alkaline earth metal halide and a phosphorous-containing compound $P(YR)_n$, wherein Y is absent or oxygen or sulphur, n is an integer 2, 3 or 4 and R is selected from C_1 to C_7 straight or branched chain alkyl, alkenyl, alkynyl or C_6 to C_{10} aryl or aralkyl, in organic solvent, optionally containing water, at a temperature of about -10 to about 50°C to produce a compound of Formula IV,

b) converting the compound of Formula IV to an ylide of Formula V by reacting with a base,

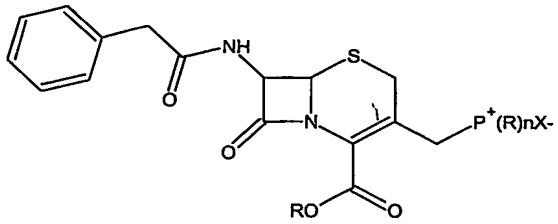
c) reacting the ylide of Formula V with 4-methylthiazole-5-carboxaldehyde of Formula VI in a mixture of organic solvent at a temperature of about –50 to about 10°C to produce a compound of Formula VII,

d) deprotecting the carboxyl functionality of the compound of Formula VII using phenol or its ether to produce a compound of Formula VIII, and

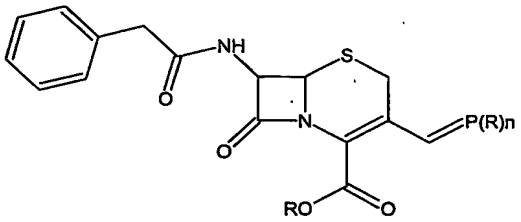
e) enzymatically deacylating the compound of Formula VIII to produce a compound of Formula IX.



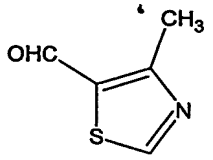
FORMULA II



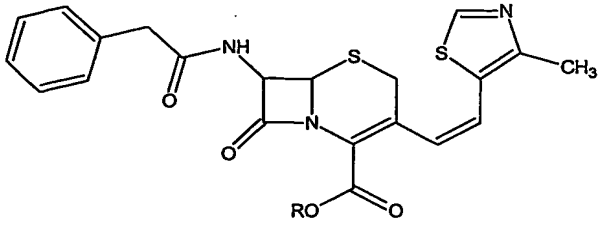
FORMULA IV



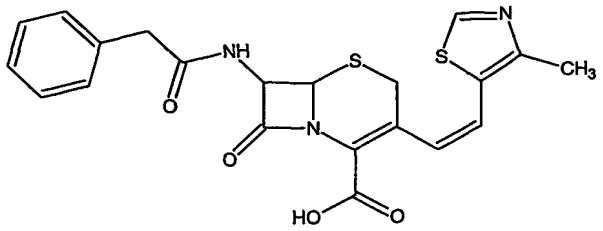
FORMULA V



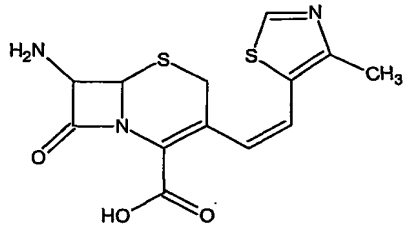
FORMULA VI



FORMULA VII



FORMULA VIII



FORMULA IX

33. The process according to claim 32, wherein the process is carried out without isolating any intermediate.

34. A process for preparation of cefditoren or pharmaceutically acceptable salt or ester thereof comprising:

a) converting a compound of Formula II to a compound of Formula IX, through intermediates IV, V, VII and VIII with a proviso that the reaction sequence is carried out without isolating any intermediate,

b) reacting the compound of Formula IX with a compound of Formula X wherein Z is selected from Xa, Xb, Xc and Xd, and R_c is selected from Formulae Xa, Xb, Xc and Xd and R_c is selected from trityl (triphenylmethyl), acetyl, benzhydryl or acetamidophenyl, R is C_1 to C_7 straight or branched chain alkyl, alkenyl, alkynyl or C_6 to C_{10} aryl or aralkyl, R_1 is C_{1-6} straight or branched chain alkyl, cycloalkyl, aryl, aralkyl or a heterocycle residue,

c) isolating cefditoren or a pharmaceutically acceptable salt thereof from reaction mass, and

d) optionally converting cefditoren or a pharmaceutically acceptable salt thereof to a pharmaceutically acceptable ester of cefditoren.

35. Z-isomer of cefditoren pivoxil having less than 2% of corresponding E-isomer.

36. Z-isomer of cefditoren pivoxil having less than 2% of corresponding E-isomer, wherein the Z-isomer is isolated from reaction mass without any purification.

37. Z-isomer of 7-ATCA having less than 1% of corresponding E-isomer, wherein the Z-isomer is isolated from reaction mass without any purification.

38. Use of the Z-isomer of 7-ATCA according to claim 37 in preparation of cefditoren or pharmaceutically acceptable salt or ester thereof.